WE CLAIM:

1. A method for electroplating platinum, comprising:

a) providing a substrate; and

b) electrolytically depositing a metal layer on a surface of said substrate, wherein said metal layer comprises platinum and a supplementary constituent,

wherein said metal layer is deposited from a single electrolyte composition during a single electrolytic step,

wherein said electrolyte composition comprises a platinum salt and particles of said supplementary constituent, and

wherein said particles of said supplementary constituent are deposited in said metal layer from said electrolyte composition.

2. The method of claim 1, wherein said supplementary constituent comprises at least one element selected from the group consisting of Al, Cr, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

3. The method of claim 1, wherein said supplementary constituent comprises chromium oxide or chromium.

4. The method of claim 1, wherein said supplementary constituent comprises chromium oxide, and at least one reactive element selected from the group consisting of Al, Cr, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

5. The method of claim 1, wherein said supplementary constituent comprises a chromium alloy including at least one metal selected from the group consisting of Al, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

6. The method of claim 1, wherein said particles of said supplementary constituent have a mean diameter of from about 1 to 50 microns.

7. The method of claim 1, wherein said particles of said supplementary constituent comprise a mixture of chromium powder and particles of at least one reactive element selected from the group consisting of Al, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

8. The method of claim 1, wherein said substrate comprises an alloy, and the method further comprises:

c) after said step b), aluminizing said substrate; and

d) heating said substrate to form an intermetallic matrix coating, wherein said intermetallic matrix coating comprises platinum, aluminum, said supplementary constituent, and constituents of said alloy substrate.

9. The method of claim 1, wherein said electrolytically deposited metal layer forms a coating on a surface of said substrate, said coating comprising said supplementary constituent, and said substrate comprising an alloy, and the method further comprising:

after said step b), heat treating said coating and said substrate surface to form a metallic solid solution comprising platinum metal, said supplementary constituent, and constituents of said substrate.

10. A method for electroplating platinum on a substrate, comprising:

a) electroplating platinum metal on said substrate via an electrolyte comprising particles of a supplementary constituent; and

b) concurrently with said step a), depositing said particles of said supplementary constituent on said substrate,

wherein said supplementary constituent is selected from the group consisting of Al, Cr, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

11. The method of claim 10, wherein said particles of said supplementary constituent are entrapped within said platinum metal.

12. The method of claim 10, wherein said particles of said supplementary constituent comprise chromium metal powder.

13. The method of claim 10, wherein said electrolyte comprises dinitrodiamine platinum.

14. The method of claim 10, wherein said step a) comprises applying a voltage of from about 1.2 to 2.2 volts between said substrate and an anode.

15. A process for preparing a coated component, comprising:

a) providing a substrate;

b) electroplating a metal layer on a surface of said substrate, wherein said electroplated metal layer comprises platinum metal and particles of at least one supplementary constituent entrapped within said platinum metal, wherein said at least one supplementary constituent is selected from the group consisting of Al, Cr, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re;

c) depositing aluminum on said electroplated metal layer; and

d) forming a platinum aluminide coating on said substrate, wherein said platinum aluminide coating comprises said at least one supplementary constituent.

16. The process of claim 15, wherein said particles and said platinum metal are co-deposited from a single electrolyte composition, and said electrolyte composition comprising said particles.

17. The process of claim 16, further comprising:

e) during said step b), maintaining said particles in suspension.

18. The process of claim 16, wherein said electrolyte composition comprises from about 0.2 to 400 g/L of said particles, and wherein said particles comprise chromium metal powder.

19. The process of claim 15, further comprising:

f) after said step b) and prior to said step c), heating said substrate.

20. The process of claim 19, wherein said step f) comprises heating said substrate to a temperature sufficient to bond said electroplated metal layer to said substrate.

21. The process of claim 20, wherein said temperature sufficient to bond said electroplated metal layer to said substrate is in the range of from about 300 to 650° C.

22. The process of claim 19, wherein said step f) comprises heating said substrate to a temperature sufficient to interdiffuse at least a portion of said electroplated metal layer with said substrate.

23. The process of claim 22, wherein said temperature sufficient to interdiffuse at least a portion of said electroplated metal layer with said substrate is in the range of from about 1000 to 1100° C.

24. The process of claim 15, wherein said substrate comprises an alloy, and wherein said step d) comprises heating said substrate to a temperature sufficient to form said platinum-aluminide coating from said platinum metal, said particles of said at least one supplementary constituent, and constituents of said substrate, wherein said platinum-aluminide coating comprises an intermetallic or metallic solid solution phase, wherein said intermetallic or metallic solid solution phase comprises Pt, Al, said at least one supplementary constituent, and said constituents of said substrate.

25. The process of claim 15, wherein said step d) comprises heating said substrate to a temperature in the range of from about 1000 to 1100° C.

26. A coating for a substrate, said coating prepared according to the process of claim 11.

27. A process for preparing a coated component, comprising:

a) providing a substrate;

b) electroplating a platinum metal layer on said substrate, wherein said platinum metal layer is electrodeposited via an electrolyte composition comprising chromium particles;

c) concurrently with said step b), depositing said chromium particles on said substrate, wherein said chromium particles are entrapped within said platinum metal layer;

d) optionally, exposing said substrate to a first heat treatment;

e) thereafter, aluminizing said substrate; and

f) exposing said substrate to a second heat treatment to form a platinum aluminide coating on said substrate, wherein said platinum aluminide coating comprises:

chromium within an intermetallic solid solution phase, and

said chromium particles dispersed within said intermetallic solid solution phase.

28. The process of claim 27, wherein said electrolyte composition further comprises dinitrodiamine platinum.

29. The process of claim 27, wherein said electrolyte composition further comprises at least one reactive element selected from the group consisting of Al, Cr, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

30. The process of claim 27, further comprising:

g) during said step b), stirring said electrolyte composition to maintain said chromium particles in suspension.

31. A component comprising:

a metal substrate; and

a platinum aluminide coating disposed on said substrate, wherein said platinum aluminide coating comprises platinum and a supplementary constituent comprising at least one element selected from the group consisting of Al, Cr, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re,

wherein said supplementary constituent is co-electrodeposited with said platinum,

wherein during a heat treatment said supplementary constituent at least partially dissolves and is incorporated into an intermetallic phase or at least one solid solution phase,

wherein said intermetallic phase or said at least one solid solution phase is formed by reaction of said platinum, said aluminum, and constituents of said metal substrate, and

wherein said coating is substantially free from chlorine, sulfur, phosphorus, or compounds thereof.

32. The component of claim 31, wherein:

said platinum aluminide coating comprises a bond coating, and

said component further comprises a thermal barrier coating disposed on said bond coating.

33. The component of claim 32, wherein said thermal barrier coating comprises a stabilized zirconia.

34. The component of claim 31, wherein said substrate comprises iron-, nickel-, or cobalt-base alloys or a nickel-base superalloy.

35. The component of claim 31, wherein said substrate comprises a blade or vane for a gas turbine engine.

36. A corrosion and oxidation resistant coating, comprising:

electrodeposited platinum;

a supplementary constituent, wherein said supplementary constituent is co-electrodeposited with said platinum; and

deposited aluminum;

wherein said corrosion- and oxidation resistant coating comprises a platinum aluminide coating, said platinum aluminide coating consisting primarily of at least one intermetallic solid solution phase, and

wherein said supplementary constituent is chromium, and wherein said coating is substantially free from chlorine, sulfur, phosphorus, or compounds thereof.

37. The coating of claim 36, wherein said coating has a thickness in the range of from about 5 to 100 microns.

38. The coating of claim 36, wherein said coating comprises from about 2 to 35 weight % chromium.

39. The coating of claim 36, wherein said coating comprises from about 15 to 25 weight % chromium, and from about 10 to 30 weight % aluminum.

40. An electrolyte composition for electrodeposition of platinum, comprising:

a platinum salt;

a carbonate or bicarbonate of an alkali metal; and

particles of at least one supplementary constituent, wherein said at least one supplementary constituent is selected from the group consisting of chromium, chromium oxide, a chromium alloy, and a reactive element, and wherein said reactive element is selected from the group consisting of Al, Cr, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

41. The electrolyte of claim 40, wherein said platinum salt comprises dinitrodiamine platinum, and wherein said electrolyte is substantially free from chlorine, sulfur, phosphorus, or compounds thereof.

42. The electrolyte of claim 40, wherein said at least one supplementary constituent comprises from about 0.1 to 80 g/L, and wherein said particles have a mean diameter in the range of from about 1 to 50 microns.

43. An electrolyte composition for electrodeposition of platinum, comprising:

dinitrodiamine platinum;

an alkali metal carbonate or bicarbonate; and

chromium metal powder in an amount of from about 0.2 to 80 g/L.

44. The electrolyte of claim 43, wherein said dinitrodiamine platinum comprises from about 25 to 55 g/L.

45. The electrolyte of claim 43, wherein said alkali metal carbonate or bicarbonate comprises from about 1 to 200 g/L.

46. The electrolyte of claim 43, wherein said chromium metal powder comprises chromium particles having a mean diameter in the range of from about 1 to 50 microns.

47. The electrolyte of claim 43, further comprising particles of at least one reactive element selected from the group consisting of Al, Y, Zr, Hf, La, Sc, Si, Ni, Co, Fe, Ta, and Re.

48. The electrolyte of claim 47, wherein said reactive element is selected from the group consisting of Y, Zr, Hf, La, and Sc.